

REMARKS

Claims 1-22 are pending. Claims 1, 11, 12, 16, and 20 have been amended to place the claims in condition for allowance or in better condition for appeal.

In the Office Action mailed April 13, 2004, the Examiner found the oath and declaration to be defective due to non-dated and/or non-initialed alterations. In response, Applicants have prepared a supplemental oath or declaration which is included herein.

The specification is amended as indicated above to reference Figure 4 correctly on page 17, line 3.

The Examiner objected to the specification for failing to provide proper antecedent basis for the term "relative addresses." While relative addressing has ample support in the specification, in order to advance prosecution, Applicants have amended claims 1, 12, 16, and 20 to address these informalities by referencing directly the language in the specification referring to relative addressing.

The Examiner rejected claim 11 under 35 U.S.C. §112, first paragraph for failing to comply with the written description requirement. The Examiner rejected claims 1-8, and 12-22 under 35 U.S.C. §103(a) as obvious in view of U.S. Patent No. 6,058,489 to Schultz et al. (hereinafter "Schultz") and U.S. Patent No. 5,671,390 to Brady et al. (hereinafter "Brady"). The Examiner rejected claims 1-22 under 35 U.S.C. §103(a) as obvious in view of U.S. Patent No. 5,758,118 to Choy et al. (hereinafter "Choy") and Brady.

Applicants have amended claims 1, 11, 12, 16, and 20 to clarify the invention and to place the case in condition for allowance and/or better condition for appeal.

REJECTION OF CLAIM 11 UNDER 35 U.S.C. §112, 1st paragraph

The Examiner rejected claim 11 under 35 U.S.C. §112, 1st paragraph for written description. Applicant has amended claim 11 to clarify the subject matter of the claim. Applicants assert that these amendments clarify that "temporarily suspending access to a RAID 5 array" and "flushing any data cached by the RAID 5 array" need not be in a specific order. See Specification page 17, line 26. Therefore, Applicants respectfully assert that claim 11 satisfies the written description requirement under 35 U.S.C. §112, 1st paragraph. Applicants request that this rejection be withdrawn.

REJECTION OF CLAIMS 1-8 and 12-22 UNDER 35 U.S.C. §103(a) IN VIEW OF SCHULTZ
AND BRADY

The Examiner rejected claims 1-8 and 12-22 under 35 U.S.C. §103(a) in view of Schultz and Brady. Applicants respectfully traverse this rejection.

PRIMA FACIE OBVIOUSNESS

Missing Elements

The PTO has the burden to establish a prima facie case of obviousness. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988); MPEP § 2142. “To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP §2143.03. Schultz and Brady do not teach all elements of the independent claims.

Claim 1, as amended, recites in part : “A method of adding an information storage device to a plurality of information storage devices in an information processing system in which a processor is connected for communication with the information storage devices by means of a log structured array (LSA) controller in which the information is stored as a plurality of stripes extending across the plurality of storage devices of the array, the LSA controller further defining a directory which specifies storage locations using ~~relative addresses~~ a construct comprising a stripe number and an offset.” Consequently, claim 1 recites the addition of a storage device to a RAID storage array controlled by an LSA controller by logically appending the additional storage device without moving all data in the array to conform to a RAID 5 configuration.

Neither Schultz nor Brady teach or suggest the addition of a storage device to a RAID storage array controlled by an LSA controller by logically appending the additional storage device without moving all data in the array to conform to the new configuration. Brady teaches reducing the need for memory by creating an LSA subdirectory. *Brady* Abstract. In addition, the LSA array in Brady is an N+M array. *Brady* at col. 5, 52-54. Applicants find no teaching or suggestion in Brady to add a storage device.

Schultz teaches adding a storage device to a RAID array by moving each stripe to a posting cache and then back to the RAID array configured with the additional storage device.

Schultz at col. 2, 41-64, col. 3, 4-10, Figs. 2A-2F. The claimed invention does not claim moving the data in all stripes to new locations as does *Schultz*. Furthermore, *Schultz* includes no teaching of adding a device to an RAID system controlled by an LSA controller. Because neither *Schultz* nor *Brady* teach the claim elements, the Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness.

Motivation to Combine

For an obviousness rejection, there must be some reason or motivation to combine references. In *In re Lee*, the court held that “[w]hen patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness.” 277 F.3d 1338, 1342, 61 USPQ2d 1430 (Fed. Cir. 2002). “The teaching or suggestion to make the claimed combination ... must be found in the prior art, not in applicant's disclosure.” MPEP 2143, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The examiner asserts that under 35 U.S.C. 103(a), claims 1-8, 12-22 are rejected as being unpatentable over *Schultz et al.* (U.S. Pat. 6,058,489) in view of *Brady et al.* (5,671,390). Applicants respectfully assert that there is no suggestion, motivation, or teaching in *Schultz* or *Brady* to lead one skilled in the art to combine the references.

Schultz teaches expansion or contraction of an array of disks in a RAID array. *Schultz* at col. 2, 41-43 (“A disk controller according to the present invention performs on-line reconfiguration of RAID 1, RAID 4 or RAID 5 disk arrays in a hard disk drive system.”). Again, *Schultz* teaches reconfiguration of a RAID array by a process of identifying pre-reconfiguration data as a source logical volume and then reconfiguring the data into destination logical volume configuration. *Id.* at col. 2, 41-64, col. 3, 4-10, Figs. 2A-2F. *Schultz* describes in detail the hardware required for a RAID configured disk storage array. *Id.* at col. 3, 66-col. 8, 8, Fig. 1. There is no mention in *Schultz* of any other storage disk configuration or that the invention applies to any other configuration. As noted by the examiner, there is specifically no mention of a Log Structure Array (LSA). In addition, there is no mention of an LSA directory, an LSA sub-directory, a garbage collection system, a bitmap detailing valid and invalid data, or any other

hardware or software necessary to make an LSA disk storage system workable with the Schultz invention.

Brady describes a particular embodiment of an LSA disk storage system that uses an LSA sub-directory to reduce the amount of memory required for a typical LSA system. *Brady* Abstract. There is no teaching of expansion or contraction of the number of disks in an array. In addition, Brady describes a particular embodiment of an LSA controller with N+M disks where M disks include redundancy segments. *Id.* at col. 5, 16 and Figure 1; *See e.g., Milligan*, U.S. Pat. 5,124,987, col. 5, 15-16.

The examiner also states that the applicant's invention claims "relative addressing" and points out that since Brady also includes relative addressing that the applicant's claim of unobviousness is without merit. Relative addressing is a feature of LSA disk storage systems since an LSA directory maps a logical drive to a current physical location of data on the disk drives. Relative addressing is used for an LSA since data on the disk drives changes from time to time because of the nature of the LSA system. Data in an LSA system is compressed. Because of data compression, once data is changed the changes may not be the same size as the data prior to the update. The data may not fit in the previous location and is stored in a new location. This creates a need to track data movement and creates "holes" where data is no longer valid. A bit map is used to track which segments have valid data. A garbage collection system is used to consolidate data in areas with a large number of holes. One way to map valid data in an LSA system is through the use of relative addressing. In the claimed invention, a form of relative addressing referred to as offset addressing is used. Relative addressing comprises valid data used as an offset from a specific location or element such as a stripe number, a column number, a track number, etc. is used.

RAID arrays make use of absolute addressing because when data is updated a segment is retrieved from the array of disks, the track being modified is updated, and the segment is then copied back to the same location as before. This is possible since the data is not compressed. In the claimed invention with LSA, the new segment-columns for a new device can be registered by simply appending the segment-columns to a segment. For example if a segment is limited to four columns and a fifth column is added, the number of columns in the address need only be changed from 4 to 5. The extra segment-column is then available for use. Shifting data or parity data to

the new segment-column then is a tradeoff of computer resources and performance, but is not a necessary step as is taught by Schultz. The inventive leap from adding a device to a RAID system to adding a device to an LSA system is significantly different and is not a trivial/obvious change.

If Schultz intended to provide a motivation to combine his invention with an LSA controlled system, which is very different than RAID and is much more than a minor variation, Schultz would have mentioned LSA specifically or indirectly by referencing the additional hardware and software required for LSA - but no such reference is present.

Based on case law, the applicant respectfully renews the argument that the examiner has not made a *prima facie* case of obviousness because there is no "teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness." *Lee*, 277 F.3d at 1342.

Hindsight

"[I]t is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious. . . This court has previously stated that '[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.'" *In re Fritch*, 23 U.S.P.Q.2d 1780, 1784 (Fed. Cir. 1992). Because neither Schultz nor Brady teaches combining the references to achieve adding a storage device to an LSA RAID array without reconfiguring data in the array, only hindsight could be used to combine the references. As indicated above, hindsight is not permitted in combining references. Applicants respectfully submit that the Examiner has not met the burden of *prima facie* obviousness because combining Schultz and Brady requires hindsight provided only by Applicants' disclosure.

Destroys Utility

"The prior art can be modified or combined to reject claims as *prima facie* obvious as long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)." MPEP § 2143.02. Combining Schultz and Brady results in an LSA RAID array with an added storage device, but the teaching in Schultz of reconfiguring all of

the data in the array destroys utility of such a combination. The present invention teaches only swapping data and parity data and thus minimizing the amount of data to be reconfigured.

Applicants respectfully submit that the Examiner has not met the burden of *prima facie* obviousness because combining Schultz and Brady destroys utility for the present invention in providing minimal swapping of data.

In order to advance prosecution, the independent claims have been amended as described above. Also as described above, the amendment regarding relative addressing further clarifies and distinguishes the present invention.

Regarding Claims 2-8, 13-15, 17-19 and 21-22

Claims 2-8, 13-15, 17-19 and 21-22 depend directly or indirectly from the independent claims. Therefore, Applicants respectfully assert that claims 2-8, 13-15, 17-19 and 21-22 are allowable for at least the same reasons as the independent claims.

REJECTION OF CLAIMS 1-10 and 12-22 UNDER 35 U.S.C. §103(a) IN VIEW OF CHOY AND BRADY

The Examiner rejected claims 1-10 and 12-22 under 35 U.S.C. §103(a) in view of Choy and Brady. Applicants respectfully traverse this rejection.

PRIMA FACIE OBVIOUSNESS

Missing Elements

As stated above, the PTO has the burden to establish a prima facie case of obviousness. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988); MPEP § 2142. Choy and Brady do not teach all limitations of the independent claims. Neither Choy nor Brady teaches the addition of a storage device to a RAID storage array by logically appending the additional storage device leaving the parity information evenly distributed among the devices and with the data of the array in a sequential order as indicated in claim 1. Again, Brady teaches reducing the need for memory by creating an LSA subdirectory. *Brady* Abstract. In addition, the LSA array in Brady is an N+M array. *Brady* at col. 5, 52-54.

Choy teaches the addition of a storage device to a RAID array by initializing the added storage device to zero, leaving all of the data and parity data in the locations they were in prior to the addition, and remapping the logical device so some parity locations are designated data and the corresponding new strip is re-designated as parity for the associated stripe. *Choy* at col. 5, 14-16, col. 5, 40-col. 6, 21, Fig. 4. The resultant array leaves the designated parity locations in a non-conventional configuration with parity information not uniformly distributed. *Id.* at Fig. 4. In a second embodiment, Choy teaches swapping data in strips with "intermediate parity storage, as shown by the Pi notation." *Choy* at col. 9, 22-col. 10, 49 (internal quotes deleted), Fig. 7. The resulting parity data is in a configuration corresponding to a RAID array as it would have been with the added storage device present when the array was first configured. *Id.* at Fig. 7. However, the data in the array is out of order and is no longer sequential. *Id.* To provide sequential data an properly distribute the parity, Choy must change the absolute addresses in the mapping instruction both for location reference and for labeling the data as data or parity data. Because the prior art does not teach the claim limitations, the Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness.

Reason to Combine

As stated above, the references must teach or suggest the combination. Applicants assert that a *prima facie* case of obviousness has not been made because neither Choy nor Brady include a suggestion or motivation to modify or combine these references to arrive at the claimed invention.

Again, Choy teaches the expansion of an array of disks in a RAID array. *Choy* Abstract. As discussed above, Choy teaches two embodiments that either leave the parity data in a non-standard diagonal configuration or leave reconfigured data out of sequence unless absolute addresses are changed. *Choy* at Figs. 4, 7. The claimed invention does not require changing addresses because relative addressing (stripe number and offset) is used.

The specification of Choy describes in detail the hardware required for a RAID configured disk storage array. *Id.* at col. 4, 60-col. 5, 20, Fig. 1. As observed by the Examiner, Choy fails to teach or disclose an LSA controller that includes an LSA directory. Instead, Choy

describes expansion of a RAID-5 array that remaps parity tracks with little or no movement of RAID data. *See Choy* at Abstract. There is no mention in Choy of any other storage disk configuration or that the invention applies to any other non-RAID configuration. As indicated by the examiner, there is specifically no mention of a Log Structure Array (LSA). In addition, there is no mention of an LSA directory, an LSA subdirectory, a garbage collection system, a bitmap detailing valid and invalid data, or any other hardware or software necessary to make an LSA disk storage system workable with the Choy invention.

As stated above, there is no teaching in Brady of expansion or contraction of the number of disks in an array. In addition, Brady describes a particular embodiment of an LSA controller with N+M disks where M disks include redundancy segments. *Id.* at col. 5, 16 and Figure 1. *See e.g., Milligan*, U.S. Pat. 5,124,987, col. 5, 15-16. As stated above, relative addressing is a feature of LSA disk storage systems that greatly differentiates a RAID system from an LSA controlled RAID system.

Applicants submit, that if Choy intended to suggest application of his/her invention to an LSA controlled RAID system, which is very different than RAID and is much more than a minor variation, Choy would have mentioned LSA specifically or indirectly by referencing the additional hardware and software required for LSA, but no such reference is present. Applicants respectfully reassert that the Examiner has not met the burden of *prima facie* obviousness as required.

Hindsight

As discussed above, hindsight is not allowed when looking to combine references. Neither Choy nor Brady teaches combining the references to achieve adding a storage device to an LSA RAID array so the parity data is evenly and uniformly dispersed and so data in each stripe is sequential. Applicants respectfully submit that the Examiner has not met the burden of *prima facie* obviousness because combining Choy and Brady requires hindsight.

Destroys Utility

As discussed above, the prior art can only be modified or combined to reject claims as *prima facie* obvious if there is a reasonable expectation of success. Combining Choy and Brady results in an LSA RAID array with an added storage device, but the teaching of Choy destroys utility in the present invention. The resulting combination would not have parity data evenly and uniformly distributed and would not have data within a stripe in a sequential order. So long as the additional overhead of Choy in changing the absolute addresses is not taken. The present invention teaches swapping data and parity data and thus minimizing the amount of data to be reconfigured while leaving the parity data evenly and uniformly dispersed and leaving the data of a stripe in a sequential order. Applicants respectfully submit that the Examiner has not met the burden of *prima facie* obviousness because combining Choy and Brady destroys utility for the present invention.

Again, in order to advance prosecution, the independent claims have been amended as described above. These amendments were made to place the claims in condition for allowance and better condition for appeal. Also as described above, the amendment regarding relative addressing further clarifies and distinguishes the present invention.

Regarding Claims 2-8, 13-15, 17-19 and 21-22

Claims 2-10, 13-15, 17-19 and 21-22 depend directly or indirectly from the independent claims. Therefore, Applicants respectfully assert that claims 2-10, 13-15, 17-19 and 21-22 are allowable for at least the same reasons as the independent claims.

In view of the foregoing, Applicants submit that the application is in condition for immediate allowance. In the event any questions remain, the Examiner is respectfully requested to initiate a telephone conference with the undersigned.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'David J. McKenzie', written over a horizontal line.

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